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Southeast Regional Carbon Sequestration Partnership (SECARB)

Central Appalachian Coal Seam Project

Field Test Location
Russell County, Virginia

Amount and Sources of CO_2
1,000 Tons from Commercial Source

Primary Contacts

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Field Test Partners

Primary Sponsors
DOE/NETL
SSEB

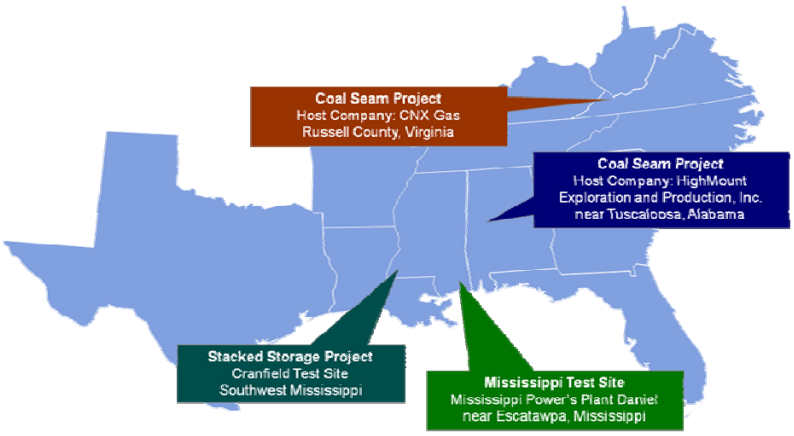
Industrial Partners
Alpha Natural Resources
AMVEST
Buckhorn Coal
CDX Gas
Dominion
GeoMet
McJunkin Appalachian
Natural Resource Partners
Penn Virginia
Piney Land and Pocahontas Land

Summary of Field Test Site and Operations

The Southeast Regional Carbon Sequestration Partnership's (SECARB) Central Appalachian Coal Seam Project field test partners have finalized indemnification and operating agreements to use a donated CNX Gas and Buckhorn Coal well for the field test in Russell County, Virginia. Design and implementation of the test are underway. The selection of the well was based on geologic considerations for the site, preliminary reservoir modeling, surface access and landowner and mineral owner negotiations.

The regional study area is located within the Central Appalachian Basin, a northeast-to-southwest-trending basin encompassing approximately 10,000 square miles in southwestern Virginia and southern West Virginia. The principal area of investigation for most of the detailed geologic mapping consists of portions of five counties located within southwestern Virginia including Buchanan, Dickenson, Russell, Tazewell and Wise Counties and four counties in West Virginia, including Fayette, McDowell, Raleigh and Wyoming.

The coals evaluated in this investigation include those of the Pocahontas and Lee Formations. The Pocahontas Formation directly overlies the late Mississippian Bluestone Formation. The sediments comprising that formation were deposited along an unstable basin that rapidly subsides to the southeast. Regionally, the formation is thickest to the southeast and generally thins to the northwest. Coal seams of the Pocahontas Formation are normally high rank, medium to low-volatile, high gas content coals that include the Pocahontas Nos. 1 through 9. The most laterally extensive and thickest of those beds is the Pocahontas No. 3 seam. Other seams within the formation may also provide favorable carbon sequestration targets.



SECARB Phase II Geographic Region and Field Test Site Locations

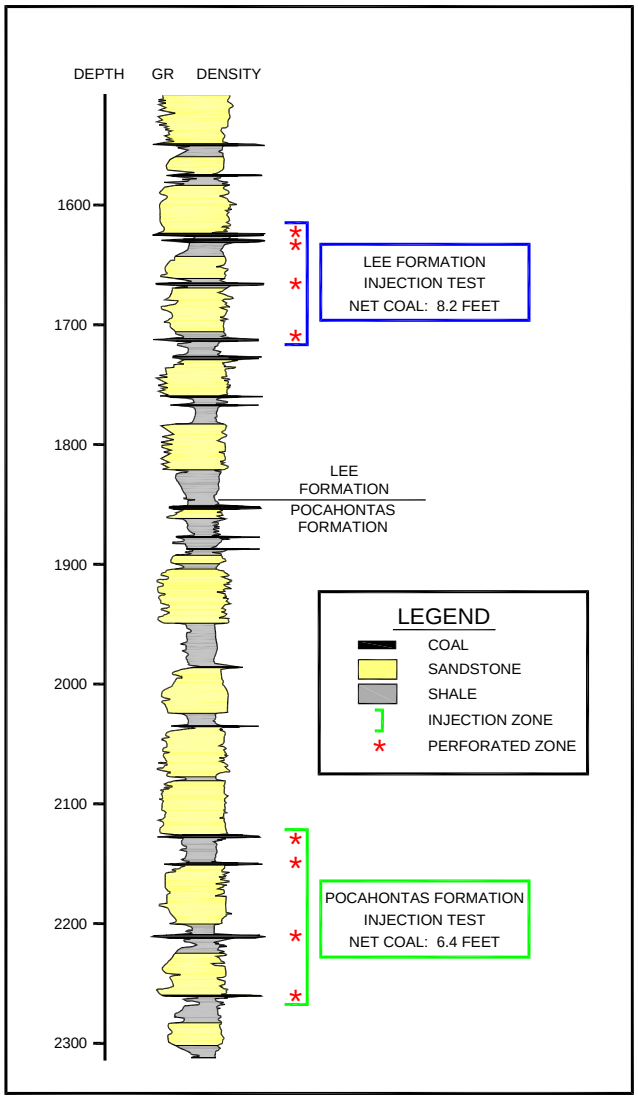


Figure 1. Field Validation Test Site Injection Zones

The sediments comprising the Lee Formation unconformably overlie Pocahontas Formation strata within the study area. Overall, the thickness of the formation decreases from southeast to northwest reflecting the progradation of the deltas from a southeastern source area across the basin to the northwest. The major seams recognized for the Lee Formation include the Upper Seaboard, Greasy Creek, Middle and Lower Seaboard, Upper and Middle Horsepen, C-Seam, War Creek and Lower Horsepen coals. The Lee Formation coals are typically medium to low-volatile bituminous in rank within the study area. The Lee and Pocahontas Formation coals are favorable reservoirs for carbon sequestration due to their thickness, depth, rank and permeability characteristics.

For the field validation test, an existing coalbed methane (CBM) well will be converted for carbon dioxide (CO_2) injection. The surface of the proposed site is mountainous terrain at 2,000' above sea level that was previously strip-mined. Access to the site will be on coal strip roads and the off-set core hole sites will be on stable strip benches. This will allow for minimal land disturbance.

The targeted coal seams are in the Pocahontas and Lee formations and include the Pocahontas Nos. 3 - 9 coal seams. The formation depth is approximately 2,200 feet to bottom of formation. The targeted coal seams range from 1,600-2,200 feet deep. The regional dip of the targeted coal seam at the proposed site dips 1.4 feet per 1,000 feet from West to East and 1.2 feet per 1,000 feet from South to North. The thickness of each of the three targeted seams range from 2.0 – 2.6 feet thick for a total thickness of 6.8 feet. The total thickness of coals completed at the well site is 18.2 feet. The average temperature of the bottom coal seam across the area is 74 degrees Fahrenheit. The permeability ranges from 5-20 millidarcies in the producing coal seams throughout the area. The porosity is approximately one percent in the producing coal seams. Salinity values range from 40,000 – 130,000 parts per million.

The targeted coal seams are commonly interbedded with carbonaceous shale. These geophysically identified shale layers above the coal seams are known seals that should contain the CO_2 injected into the target coal seams. A regional structure map was generated that includes thrust faults, transverse faults, anticlines and synclines. The potential leakage points could include these fault systems and networks, joint systems or existing borehole penetrations related to CBM or natural gas production.

The principal construction requirements under this program will include the drilling of core holes and the installation of monitoring apparatus. Two core holes will be drilled around the injection well at approximately 150-300 feet, the exact distances to be determined on the basis of reservoir models. After the cores are removed for analysis, the core holes will be converted into monitor wells and pressure transient tests will be performed in both the core holes and injection

wells. Isolation packers and slim-hole monitoring equipment will be installed to observe reservoir pressure and gas composition during injection of CO_2. The injection operation will include the injection of 1,000 tons of CO_2 into two different coal seams.

The formation is very well characterized based on core hole data and immense amounts of geophysical data throughout the area. The following two figures illustrate a geologic stratigraphic column (Figure 1) showing the target formation and potential seals of the proposed field validation test site and the locations of the potential test sites (Figure 2).

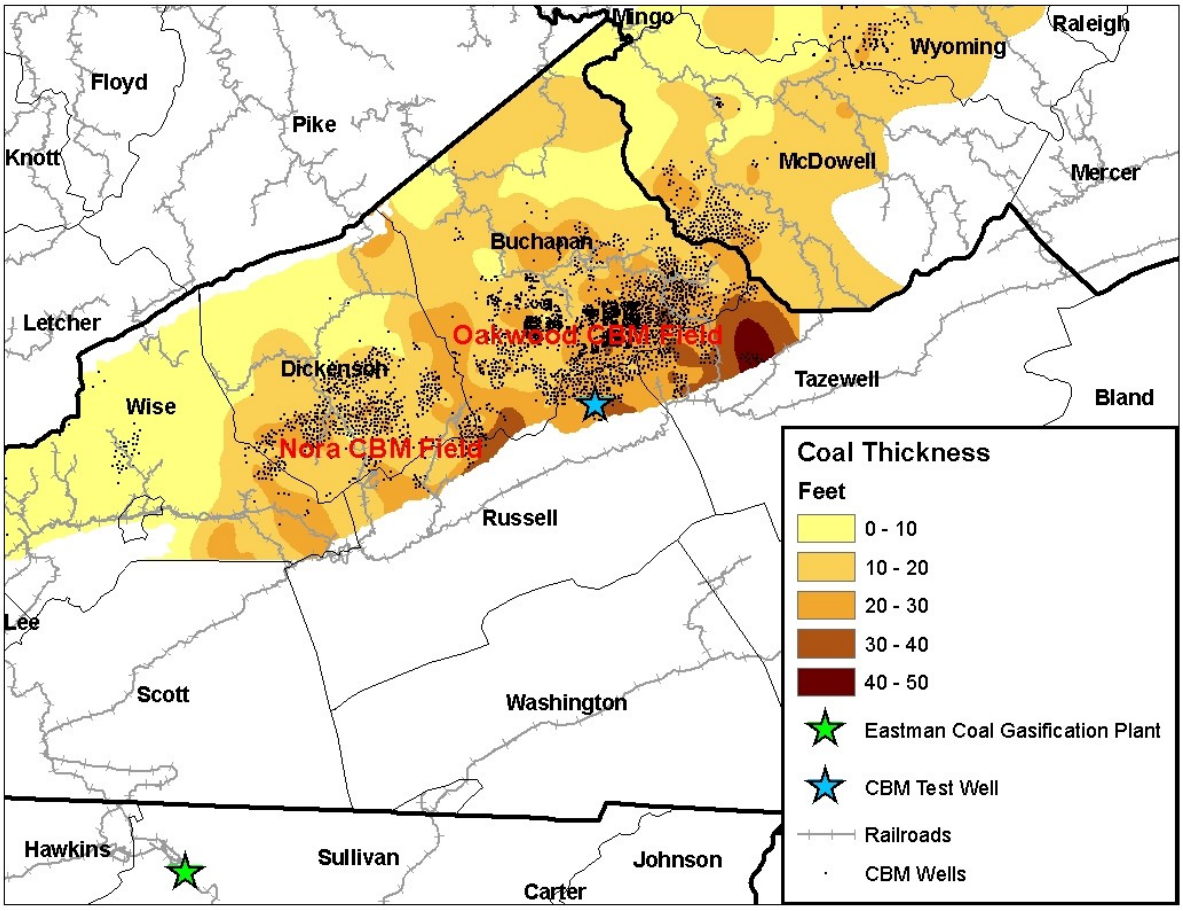


Figure 2. Field Validation Test Site

Research Objectives

The objectives under this field validation test are to assess and to verify the sequestration capacity and performance of mature CBM reservoirs in the Central Appalachian Basin through injection-falloff and production testing, as well as the implementation of subsurface monitoring programs. These tests will demonstrate the potential geologic sequestration into Appalachian coals as a safe and permanent method to mitigate greenhouse gas emissions. The objectives of the project are directly related to the following tasks: expanded geologic characterization, pilot site selection, reservoir modeling, core hole drilling and evaluation, pilot preparation and risk analysis, pilot testing and injection operations, data interpretation and assessment, and public outreach and technology transfer.

Summary of Modeling and MMV Efforts

Reservoir modeling activities are lead by a team from Advanced Resources International using their COMET3 reservoir simulator, the industry-leading choice for desorption-influenced reservoirs. Reservoir modeling is an important component in understanding the mechanisms involved in carbon sequestration within coal seams. Four types of reservoir modeling efforts will be necessary during the course of the project. These will be: (1) review of the selected primary injection sites within the Central Appalachian Basin; (2) rigorous history matching and assessment of the preferred CO_2 injection sites, including numerous sensitivity runs, prior to CO_2- sequestration demonstration; (3) mid-course reservoir modeling to assess the performance of the project against expectations, enabling mid-course corrections to be made; and, (4) post-project history matching and performance prediction of the CO_2- sequestration pilots and their implications to CO_2 storage in the basin.

Monitoring and verification will focus on both surface and deep well monitoring and will include water composition, soil analysis, subsurface pressure and well log analysis. After the two core holes are drilled at each test site, they will be converted into deep monitor wells. Packers will be installed to isolate separate coal zones. Slim-hole equipment for observing reservoir pressure and gas composition will be installed between the isolation packers to monitor reservoir pressure and gas composition (CO_2 and CH_4). Pressure response and gas composition will be mapped using the data from the observation wells, and reservoir models will be refined on the basis of the data.

Accomplishments to Date

1. A detailed regional assessment of the Central Appalachian Basin potential carbon sequestration capacity and enhanced CBM recovery has been completed.
2. A comprehensive suite of production maps for the active CBM wells in the Central Appalachian Basin has been performed and finalized.
3. Preliminary reservoir modeling on field validation test site has been completed.
4. Site selection of the field validation test site has been completed.
5. A technology transfer and outreach program has been initiated that includes a website, publications and numerous technical and non-technical presentations at conferences and workshops.

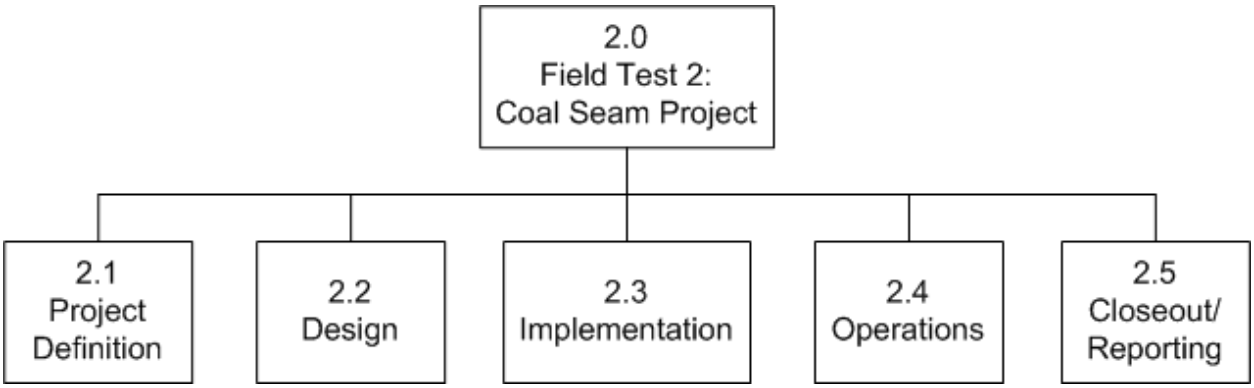
Target Sink Storage Opportunities and Benefits to the Region

The most favorable areas delineated for the proposed Central Appalachian sequestration field test are located within the coalbed methane production region in Buchanan, Dickenson, Russell, Tazewell and Wise Counties, Virginia, and in Fayette, McDowell, Raleigh and Wyoming Counties, West Virginia. Economic production in the Central Appalachian region began in 1988 with the development of the Nora CBM field by Equitable Production Company, located primarily in Dickenson County, Virginia. CONSOL Energy later commenced drilling CBM wells in the prolific Oakwood Field located in Buchanan County, Virginia, in 1990. Since that time, over 4,000 CBM wells have been drilled and completed through year-end 2005 in the Central Appalachian Basin. The prospective coal seams are known to be high rank (low to medium volatile bituminous), have high gas contents and occur at favorable depths for storage. CBM development in the area has provided extensive geological, engineering and production data, which will be made available for reservoir modeling. The CBM productivity of the province indicates that coal permeabilities should be acceptable for carbon dioxide injection. The sequestration capacity assessments for the Central Appalachian basin indicate 1,341 Million tons (MMt) of carbon dioxide storage capacity, with 398 MMt deemed technically feasible for sequestration projects. The corresponding enhanced CBM recovery potential of these coals is 0.79 – 2.49 trillion cubic feet (TCF) of gas production. Sources of CO_2 in the area are large coal-fired power plants that maybe able to supply CO_2 for sequestration projects. If the technology proves successful, the possibility exists for large economic development gains in the form of enhanced CBM production and carbon sequestration industries for the region.

Cost	Field Project Key Dates
Total Field Project Cost (Years 1-4): $2,718,223	Baseline Completed: 01/2007
DOE Share: $2,173,469 80%	Site Selection Completed: 10/2007
Non-DOE Share: $544,909 20%	Drilling Operations Begin: 03/2008
	Install Monitoring Equipment: 06/2008
	Injection Operations Begin: 07/2008
	Site Closure: 08/2009

Field Test Schedule and Milestones (Gantt Chart):

The field test schedule for SECARB's Central Appalachian Coal Seam Project can be seen in the following diagram and Gantt Chart.



Tasks	Year 1				Year 2				Year 3				Year 4			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
2.1 Project Definition																
2.2 Design																
2.3 Implementation																
2.4 Operations																
2.5 Closeout/Reporting																

Tasks Completed Tasks to be Completed